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A Document Visualization Tool Customized to Explore DRDC Reports

Peter Kwantes

Defence R&D Canada
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Abstract

HanDles is a document visualization tool developed for Defence Research and Development Canada (DRDC) - Toronto as part of ARP 15ah. In this report, a customized version of the program is described. The new version of the HanDles tool was adjusted to process the abstracts from the agency's technical reports dating back to the 1940s. In a series of short examples, the author shows how HanDles could be used as an effective and intuitive means by which civilian and military members of the Department of National Defence can find scientific or technical information about topics or personnel with specific areas of expertise.

Résumé

HanDles est un outil de visualisation de document mis au point pour Recherche et développement pour la défense Canada (RDDC) - Toronto dans le cadre du PRA 15ah. Le présent rapport contient une description d'une version personnalisée du programme. La nouvelle version de l'outil HanDles a été modifiée afin de traiter les résumés des rapports techniques de l'Agence qui remontent jusqu'aux années 40. Dans une série de brefs exemples, l'auteur montre de quelle façon les civils et les militaires du ministère de la Défense nationale peuvent utiliser HanDles de manière efficace et intuitive afin de trouver des renseignements scientifiques ou techniques sur des sujets ou du personnel possédant une expertise dans certains domaines précis.

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Executive summary

A Document Visualization Tool Customized to Explore DRDC Reports

[Peter J Kwantes; DRDC TM 2011-131]; Defence R&D Canada – Toronto; .

Introduction: HanDles is a document visualization software tool developed under contract by Ohio State University for Defence Research and Development Canada (DRDC). HanDles forms semantic representations of the documents in a collection and displays them to the user as points on the screen. The goal of this project element was to provide users, mainly Canadian Forces personnel, with an easy means by which they can find information and people in DRDC. We had our contractor create a special version of HanDles that provides an intuitive means by which a user can interact with a document collection to find out different kinds of information, like:

1. Which topics are studied by what labs?
2. What work is being done on a particular topic?
3. When did the organization start doing work on a specific topic?
4. When did work on a particular topic peak?
5. Who would I call if I wanted to find out about a specific topic or if I need work in a particular area?
6. Who in the organization works, or perhaps SHOULD work, together?

Significance: The author believes that HanDles could be an effective new way for DND/CF personnel to find people and information relevant to a user's query.

Future plans: Perhaps HanDles could be instituted as the official means by which Department of National Defence and CF personnel can interact with the agency's scientific knowledge. For this to happen, the agency would need to contract the inventors to provide a final version of the tool. This would need to be done in collaboration with DRDC Toronto, Defence Research & Development Knowledge & Information Management (DRDKIM) and DRDC Corporate.

Sommaire

Un outil de visualisation de document conçu précisément pour explorer les rapports de RDDC

Peter Kwantes; DRDC TR 2011-131; R & D pour la défense Canada – Toronto .

Introduction : HanDles est un outil logiciel de visualisation de document conçu par l'université de l'état de l'Ohio (Ohio State University) pour Recherche et développement pour la défense Canada (RDDC) en vertu d'un contrat. HanDles établit des représentations sémantiques des documents d'une collection et les présente à l'utilisateur sous la forme de points à l'écran. Le but de cet élément de projet était de fournir aux utilisateurs, principalement les membres du personnel des Forces canadiennes, une méthode leur permettant de trouver facilement des renseignements ou des gens au sein de RDDC. Nous avons demandé à notre entrepreneur de créer une version spéciale de HanDles qui offrirait à l'utilisateur un moyen intuitif d'interagir avec une collection de documents afin de trouver différentes sortes de renseignements, par exemple :

1. Quels sujets sont étudiés par quels laboratoires?
2. Quels sont les travaux en cours sur un sujet particulier?
3. Quand l'organisation a-t-elle commencé à travailler sur un sujet particulier?
4. À quel moment les travaux sur un sujet particulier ont-ils atteint leur plus haut niveau?
5. Qui devrais-je appeler si je voulais obtenir des renseignements sur un sujet précis ou si j'ai besoin de travaux dans un domaine particulier?
6. Qui sont les gens de l'organisation qui travaillent ensemble ou qui DEVRAIENT travailler ensemble?

Portée : L'auteur croit que le HanDles pourrait être une nouvelle façon efficace de trouver des personnes et des renseignements pertinents en fonction des demandes des utilisateurs du MDN et des FC.

Recherches futures : Le HanDles pourrait devenir le moyen adopté officiellement par le personnel du ministère de la Défense nationale et des Forces canadiennes pour interagir avec les connaissances scientifiques que possède l'Agence. Pour que cela soit possible, l'Agence devrait communiquer avec les inventeurs afin d'obtenir une version finale de l'outil. Cela devrait être fait en collaboration avec RDDC Toronto, la Direction - Gestion du savoir et de l'information (Recherche et développement) (DSIGRD) et le bureau principal de RDDC.

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Introduction

HanDles is a document visualization software tool developed under contract by Ohio State University for Defence Research and Development Canada (DRDC). HanDles forms semantic representations of the documents in a collection and displays them to the user as points on the screen. The more semantically similar documents are to one another, the closer they are located on the screen. Atop the document points on the screen, HanDles places concept names, or handles, that give the user a notion of what kinds of topics are being discussed by the document points around it. A “handle” is a term or n-gram that occurs frequently in the documents returned by a query, and as such plays a role in describing the important dimensions or topics discussed in the documents returned by a query. A screen shot of HanDles in response to the query “George Clooney” is shown in *Figure 1*. In this example, 17,000 articles from the Internet Movie Database were loaded into HanDles for analysis.

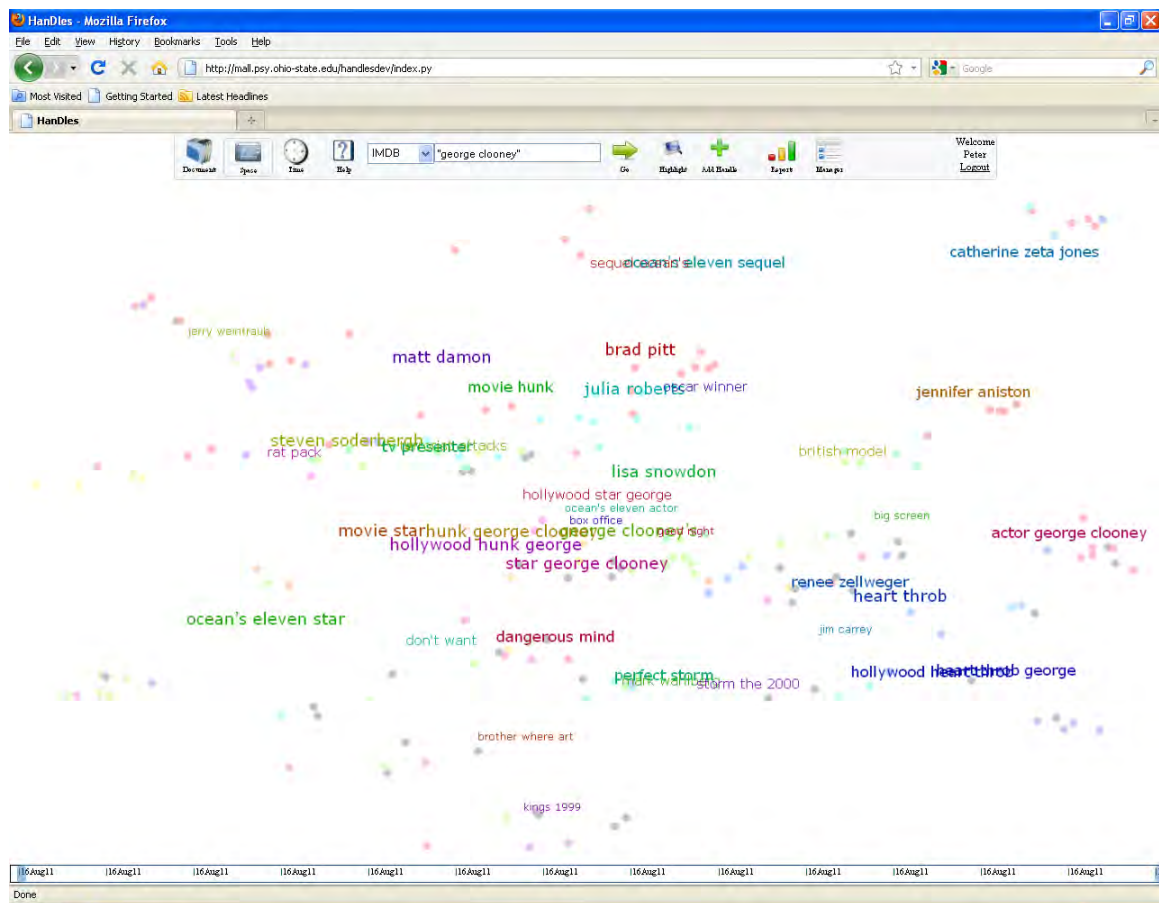


Figure 1: A screen shot of HanDles in response to the query, “George Clooney”.

There are other document visualization tools that work in much the same way. However, HanDles has an additional feature unique to it. Specifically, HanDles acknowledges that any given document will likely be about many topics, not a single topic, and as a result allows the user to discover the various topics represented by a document. For example, consider a document about

Tiger Woods having a physical altercation with his wife about his alleged affairs. What is that document about? It is about many things: golf, professional athletes, domestic violence, and infidelity. Now, imagine this document was going to be shown as a point on the computer screen with many other documents. What documents does it belong beside on the screen; documents about sports or cheating? In truth, the answer is it belongs in many categories, but forcing a multidimensional object like a document onto a two-dimensional screen precludes the user from discovering them. The solution developed by the contractor is to make the handles and documents interactive. That is, a user can grab a handle, and move it from one location of the screen to another. Any documents and handles that are semantically related to the handle will follow it, and any that are unrelated will remain still or even be repelled by it. Being able to move the contents of a query around allows the user to create his/her own semantic organization of the documents returned by a query.

A couple of more details about HanDles are worth noting. First, clicking on a handle shows the user all the documents containing the handle. *Figure 2* shows what happens in the above screen when one clicks on the handle, “Lisa Snowdon” and moves it to another location on the screen. First, by examining what other handles sit close by the documents containing Lisa Snowdon, the user can learn that Lisa Snowdon is a British model and television presenter. By moving Lisa Snowdon around, one can see what other handles are semantically related to her.

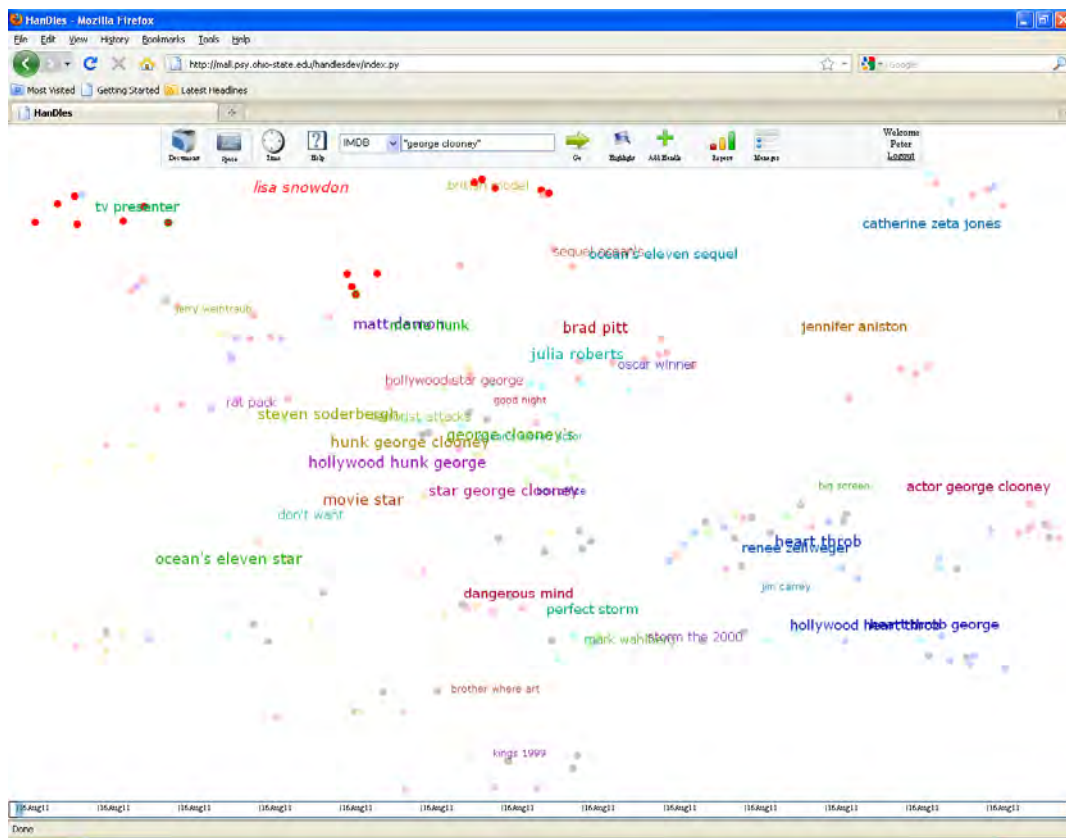


Figure 2 Move Lisa Snowdon to another area of the screen and take note of what documents and handles follow her.

By clicking on one of the documents, the user can read it (see *Figure 3*)

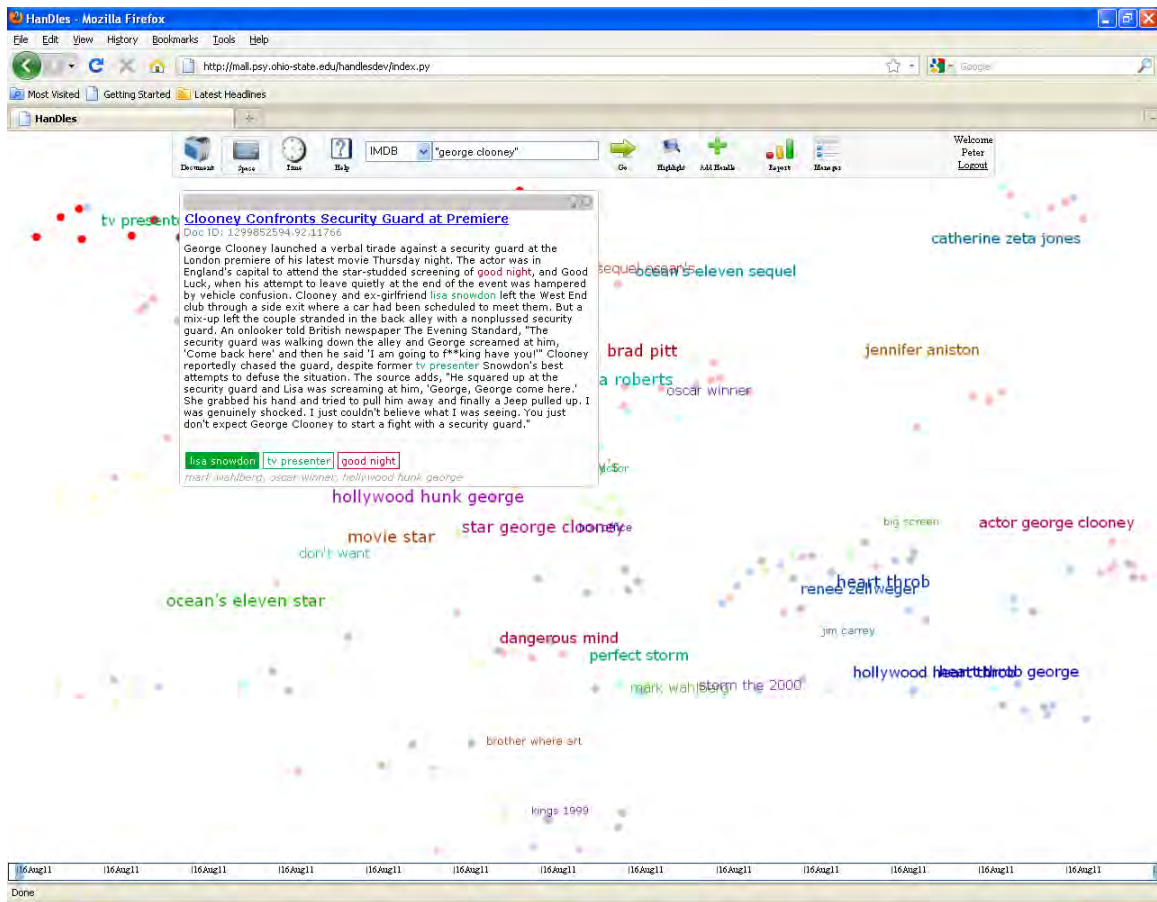


Figure 3: Clicking on a dot opens the document.

This introduction provides only a basic description of HandDles. In what follows, the tool will be described in more depth. I describe augmentations to the program to support Applied Research Project (ARP) 15ah in which it was adapted as a device for exploring the body of knowledge represented by the technical reports generated by DRDC in its current and its previous incarnations going back to the 1940s. The significant changes to the HandDles consisted of allowing authors, laboratories (condensed to five centres, TORONTO, OTTAWA, SUFFIELD, VALCATIER, ATLANTIC), and reports' key words to be treated as handles

Purpose of the work reported herein

Over the nearly seven decades of research engaged in by Canadian defence scientists, we have generated thousands of technical reports covering a multitude of research areas of pursuit. The documents we have generated as an organisation represent a living database of our research history as a scientific organisation as well as a resource for determining where our research efforts are focused. Moreover, the collection provides information about who does, or used to do, particular kinds of work in the organization. The goal of this project element was to provide users, mainly Canadian Forces (CF) personnel, with an easy means by which they can find information and people in DRDC to get answers to science and technology questions. We had our

contractor create a special version of HanDles that provides an intuitive means by which a user can interact with the DRDC document collection (containing approximately 10,000 abstracts from Technical Reports dating back to 1947) to find out different kinds of information, like:

- Which topics are studied by what labs?
- What work is being done on a particular topic?
- When did the organization start doing work on a specific topic?
- When did work on a particular topic peak?
- Who would I call if I wanted to find out about a specific topic or if I need work in a particular area?
- Who in the organization works, or perhaps SHOULD work, together?

Structure of the report

In this report, I will provide an example of each query asked in the previous section. For each query, I will walk through the process by providing several screen shots of the program. Interested readers can try the software out for themselves by pointing their browsers (Google's Chrome or Firefox 3.5 or greater, or any browser that supports HTML 5.0) to <http://mall.psy.ohio-state.edu/handlesdev/index.py>. To gain access to the technical report abstracts, you must login to Handles. There is a guest account that you can use:

Username : drdcGuest@handles.com

Password : drdcGuest

Which topics are studied by what labs?

As mentioned above, the contractor combined the various laboratory names for the same institutions. For example, DRDC Toronto, Defence and Civil Institute of Environmental Medicine, Defence Research Establishment Toronto and Defence Research Medical Laboratory all became aliased to TORONTO. The same aliasing was applied to the other labs to create the aliases, VALCARTIER, OTTAWA, ATLANTIC and SUFFIELD. From the opening screen in the tool, we enter the query *DRDCAbstracts AND TORONTO*. The *DRDCAbstracts* refers to a handle assigned to all the technical report abstracts. The handle *DRDCAbstracts* becomes used as a filter to exclude any documents in the user's home folder that are not DRDC abstracts. In other words, the *DRDCAbstracts* part of the query tells HanDles only to use those documents in the user's home directory that have the handle, *DRDCAbstracts*.

The other adjustments I made were to reduce the number of self-discovered handles returned by the query and increase the number of handles taken from the keywords included in all DRDC technical reports. I have arbitrarily set the number of keywords to 30. I also asked the system to return a maximum of 200 documents from the query. *Figures 4 through 8* show the HanDles map returned for the queries, TORONTO, VALCARTIER, OTTAWA, SUFFIELD and ATLANTIC, respectively. The terms on the screen provide an overview of the kinds of work done by the centre over the time span shown by the timeline on the bottom of the screen.

As the different figures are examined, one can easily see that TORONTO is associated with diving and exercise physiology, psychology, and human factors research, as well as work on computer displays. Indeed, each figure does a decent job of providing examples of the work done at the various labs.

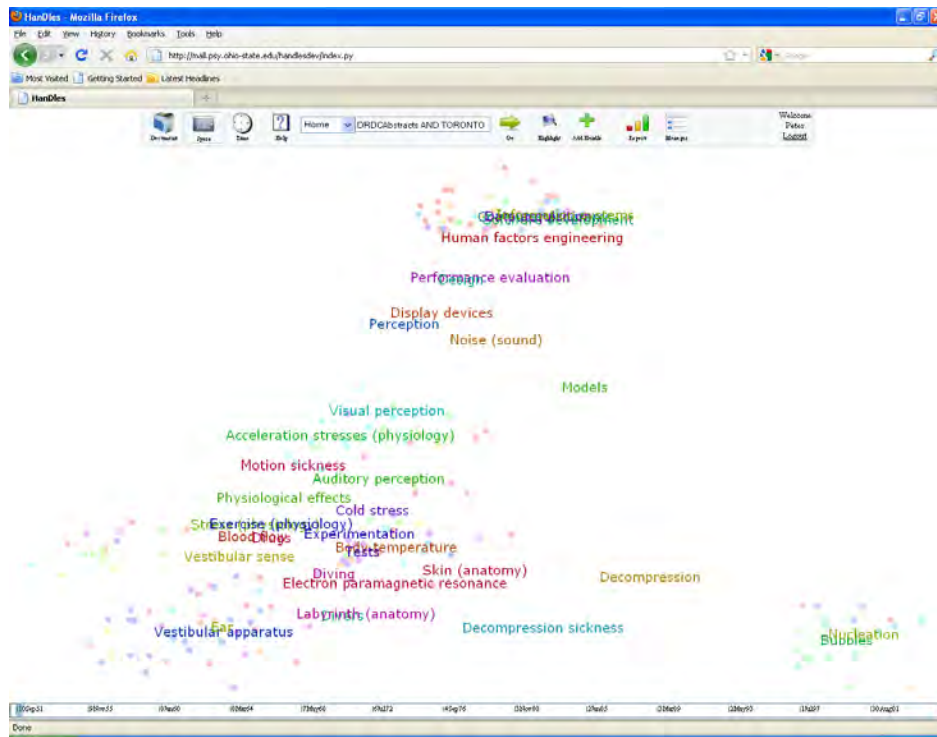


Figure 4: Research Areas found in the Toronto laboratory.

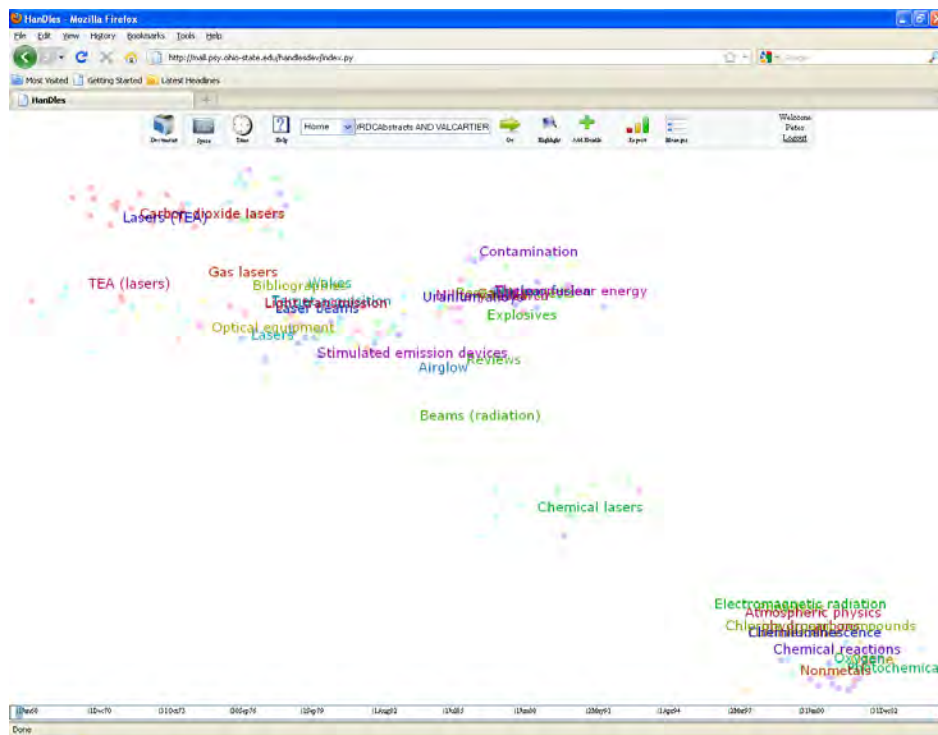


Figure 5: Research Areas found in the Valcartier laboratory

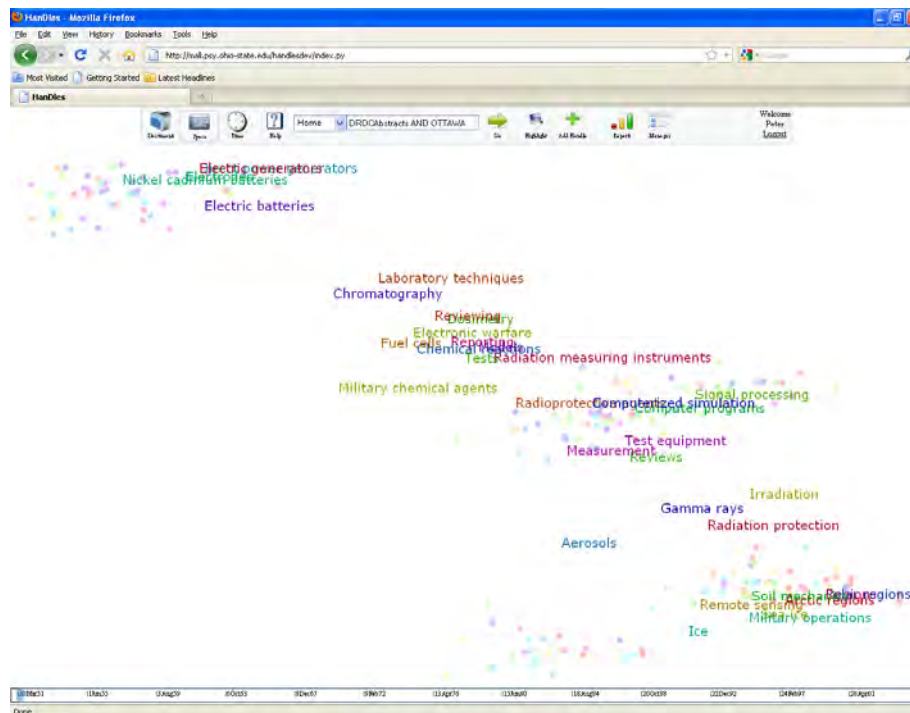
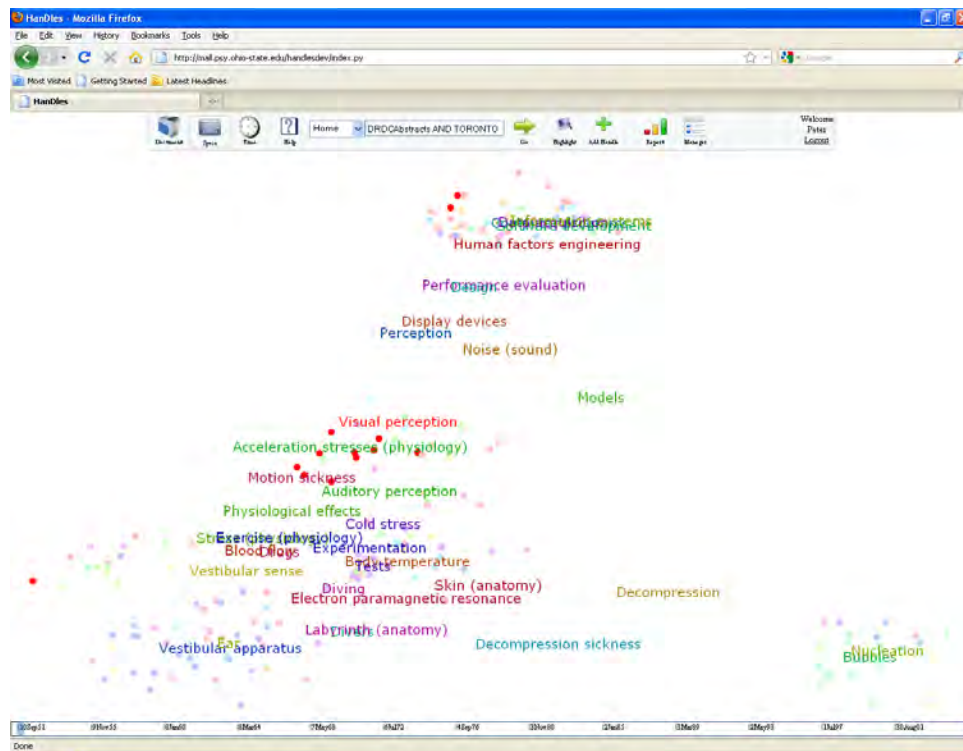


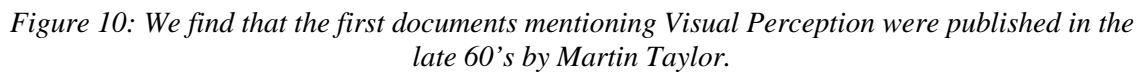
Figure 6: Research areas found in the Ottawa laboratory.



As is clear, users can extract topics from the abstract collection to get an overall picture of what kind of work has been done in the centre. There is a timeline printed at the bottom of the HandLes screenshot. The timeline allows the user to select a window of time in which to view documents. So, for example, I may be interested in the Visual Perception work that DRDC Toronto is doing, but perhaps I should know if the work is still being carried out at that location. This is addressed in the next example.

When did the Toronto laboratory start doing work on Visual Perception? We start by referring back to the screen shot in *Figure 4*. Single click on the handle called, Visual Perception. All the documents mentioning visual perception will turn red (see *Figure 9*).





What work has DRDC done in the area of Human Factors, broadly speaking? To find out, I would enter “human factors” as a query to HanDles. In this case, I have asked the program to return back forty handles, half taken from Keywords assigned to the abstracts, and half discovered on its own. The map is shown in *Figure 11*. The first thing to note is the broad area covered by the topic of Human Factors: protective clothing, aviation, workplace layout, human-computer interaction.

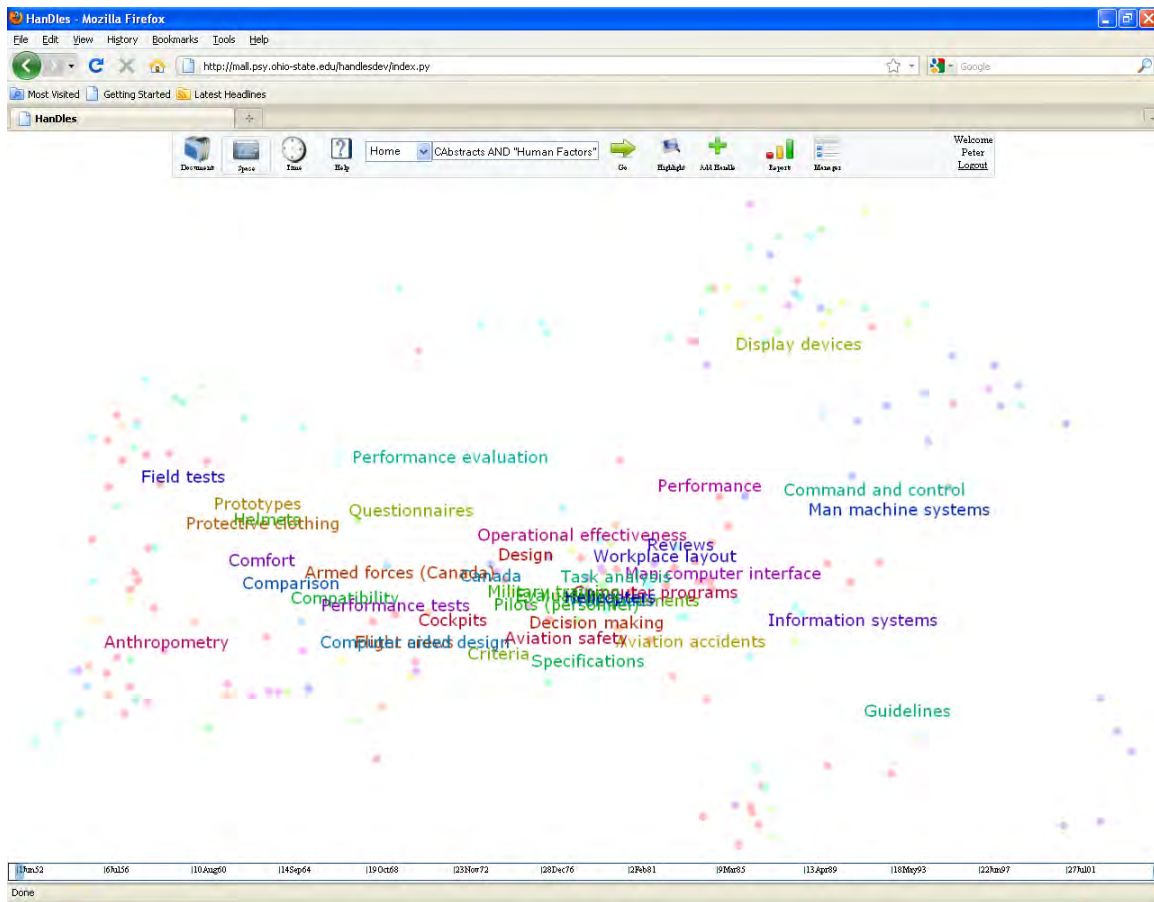


Figure 11: Handles map in response to the query, “Human Factors”.

HanDles is designed to allow the user to organize documents into meaningful semantic clusters. As can be seen in the cluster of documents and handles in *Figure 11*, there are clear areas of expertise in the organization. The areas are not isolated semantically. As a result, the concept names seem a bit cluttered. However, reading the handles from left to right, we see terms having to do with clothing and body measurement, then cockpits and other aviation handles, followed by decision making, and finally work on interfaces and human-computer interaction.

As a user, one would likely want to pull the handles (and the documents that follow them) into their own, more distinct clusters. In *Figure 12*, I have created three general clusters containing documents about protective clothing, aviation and human-computer interaction issues. To demonstrate how the documents are not semantically isolated however, I clicked on the handle, *Computer Programs* in the loose cluster about computers formed on the right of the screen to activate any documents containing that handle. Notice that not all the documents that turn red in response to the click are in that region. One activated document, for example, sits atop the handle, *Anthropometry* and the other near the handle, *Decision Making* in the Aviation area of the screen. In other words, a document about computers can be about different topics, and may be placed in a different region of the screen if the document is more about another topic than about the topic represented by the handle the user clicked. *Figure 12* demonstrates this point.

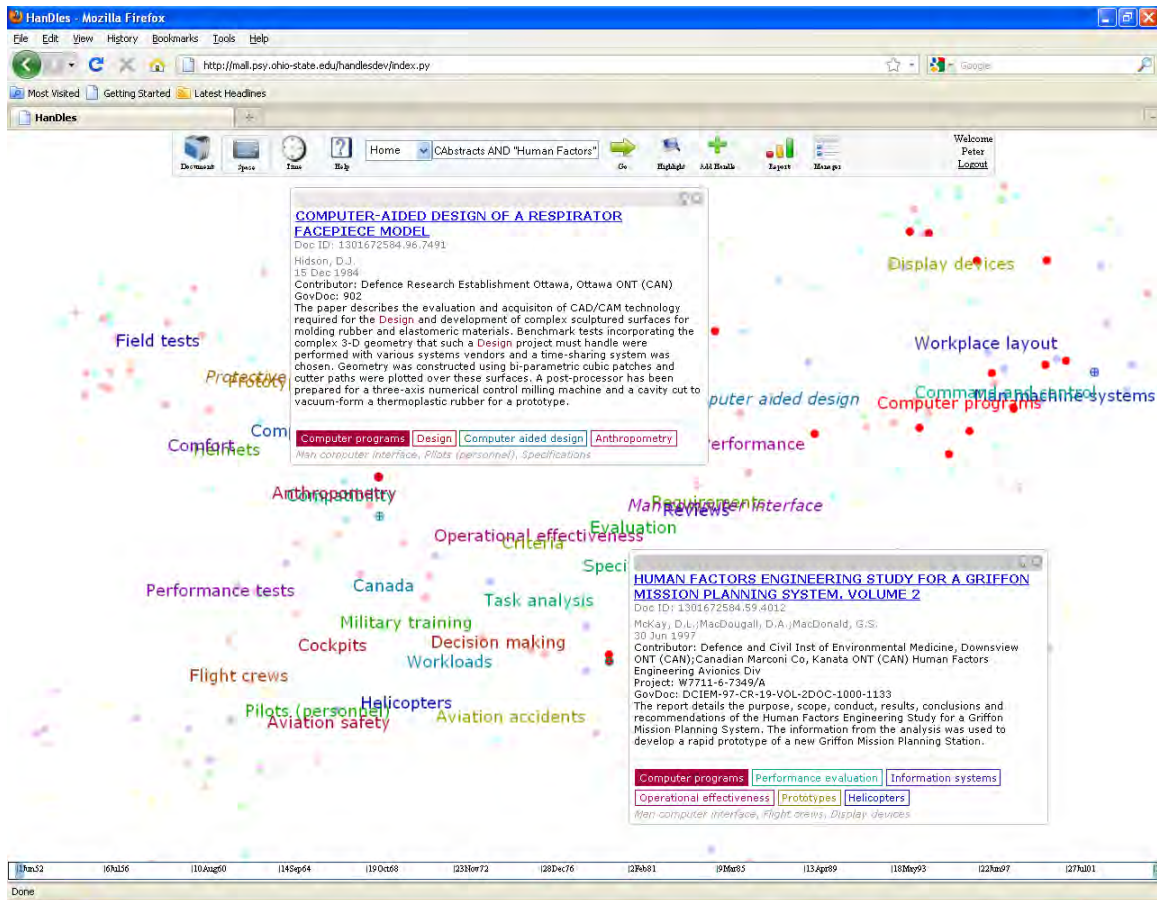


Figure 12: Creating some semantic clusters in our “Human Factors” cluster. Clicking on “Computer Programs” activates documents containing that handle. Notice that the activated document near the handle, “Anthropometry” is about computer-aided anthropometry and the document near the handle, “Decision Making” in the Aviation area of the screen is about computer work for mission planning prototype for helicopter pilots.

When did work on a particular topic peak?

When did DRDC’s work on Arctic survival peak? HandDles contains a reporting function that allows the user to see the number of papers per year containing the handles associated with a query. The button on the interface called, Time, allows the user to select which handles to track over time. The graph on the right shows the user a smoothed-out count of how many documents per year were published containing the handle. The colour of the series is matched to the colour of the handle on the legend found on the left side of the screen. In the graph shown in Figure 13, we can see that there are several handles associated with the query, Arctic, and that work in the area of Arctic survival and Arctic clothing seems to have peaked in around 1980.

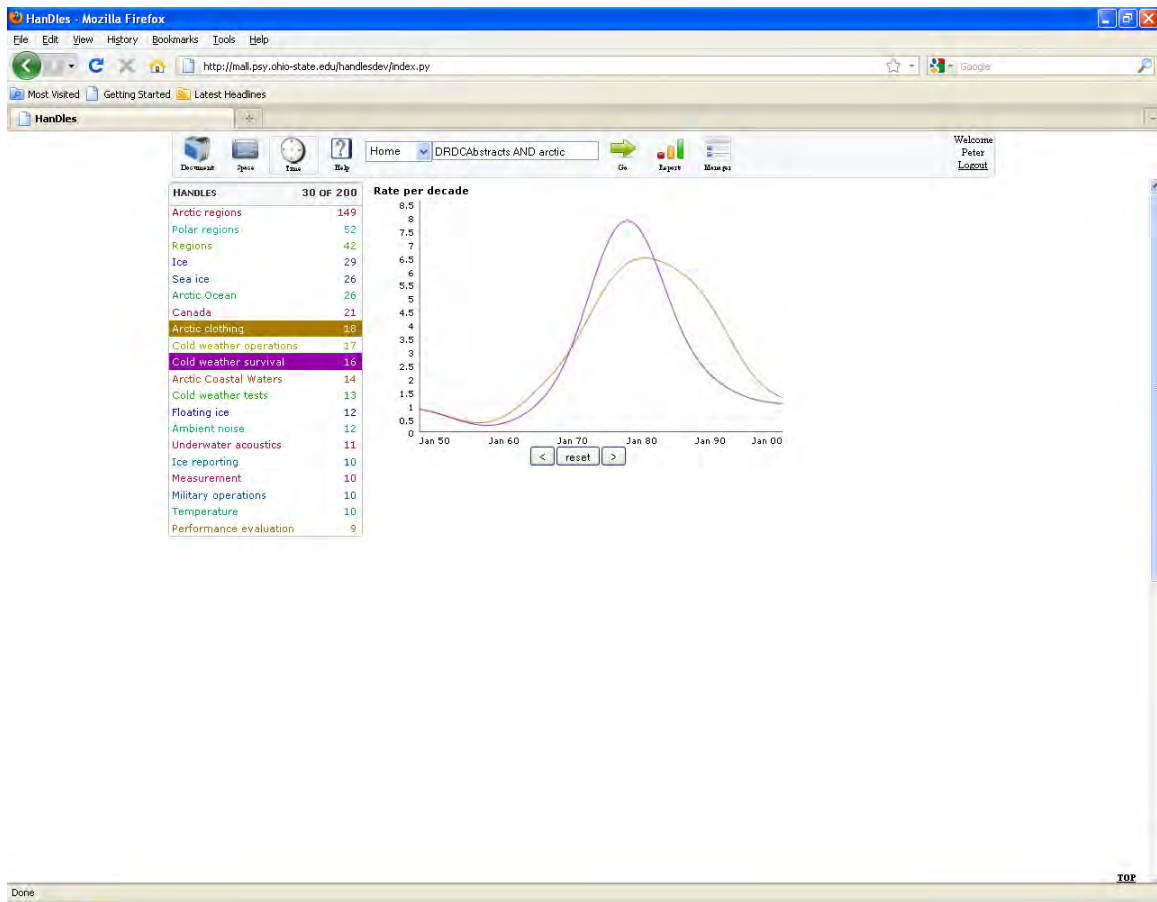


Figure 13: Tracking the number of documents a year the agency published on the topic of the Arctic.

Who would I call if I wanted to find out about a specific topic or need work in a particular area?

Suppose a commander at CFB Shearwater wanted to find out more about how he/she can best deal with issues of pilots' motion sickness in the flight simulator on base. As a first step, one would enter, "motion sickness" as a query in HanDles, and get the relevant documents returned (see Figure 14)

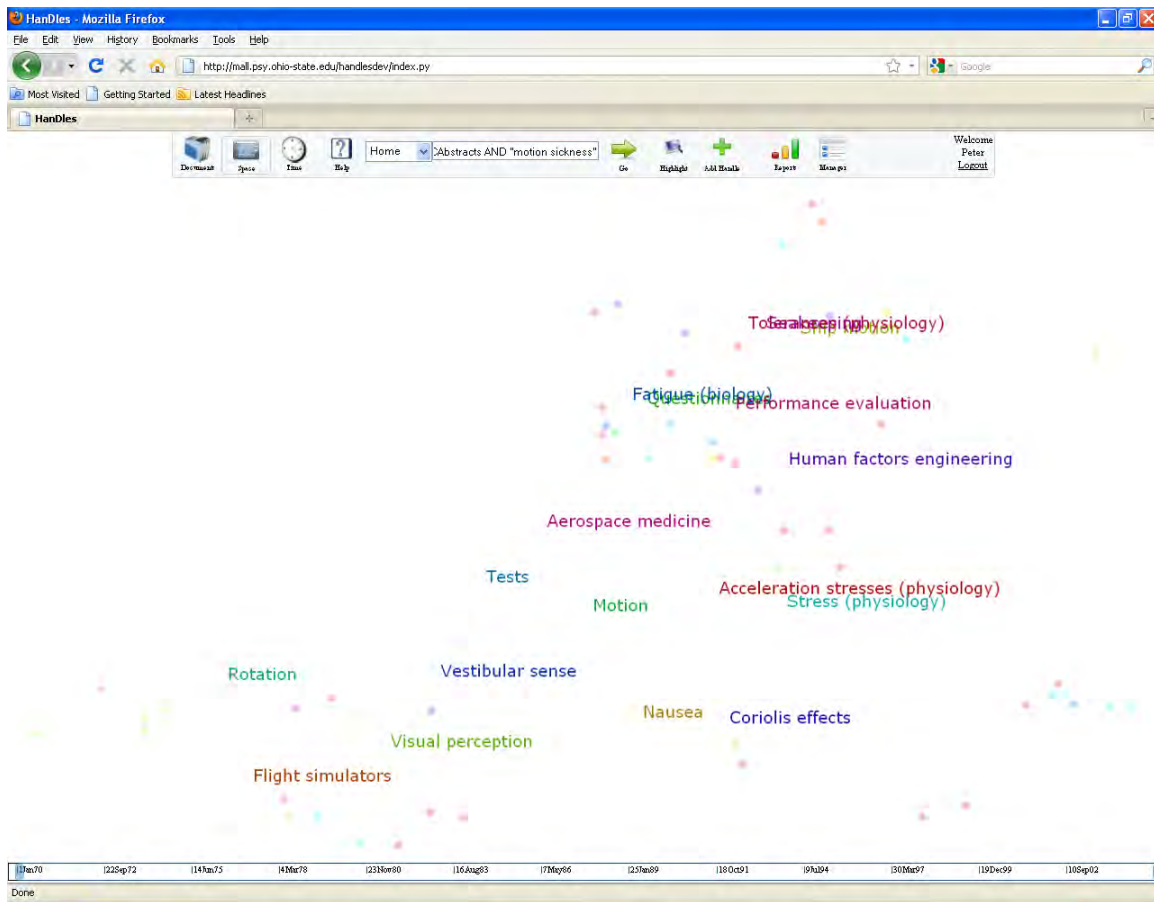


Figure 14: HanDles map in response the query, “motion sickness”

Figure 14 shows that there are documents about motion sickness, and that at least some of the documents discuss it in the context of flight simulators. Clicking on the handle, Flight Simulators will activate any documents containing that handle. From there, the user can open the activated documents and find author names as shown in Figure 15.

Who in the organization works, or perhaps *should* work together?

The customized version of HanDles also allows report authors to show up on screen as HanDles. All information in the tool, handles or documents, are represented as 100-dimensional vectors. A handle is created by summing all the vectors for the documents containing the handle. So, for example, the handle, Flight Simulator is created by summing the vectors for all of the documents containing the term “flight simulator”. HanDles uses the same method to create handles for Authors. The representation of an author’s handle is created by summing the vectors for all of the documents written by the author. For example, the handle for, “Magee, L.E” will be created by summing the vectors corresponding to the documents he wrote. We can use this representation to examine the association between authors and research topics, as well as associations between authors that may or may not have published something together.

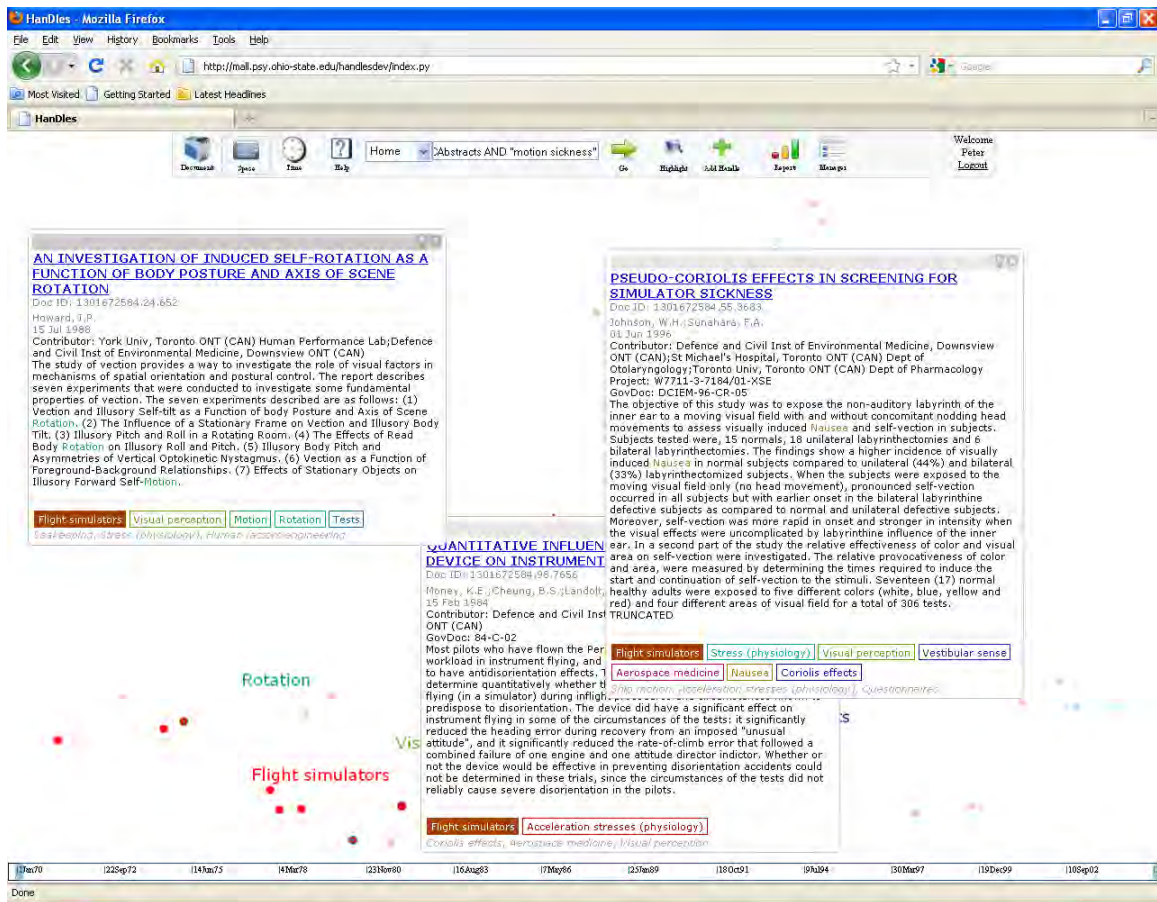


Figure 15: Finding authors of reports discussing motion sickness in the context of flight simulators.

Consider the example above regarding simulator sickness. Under the Documents tab, HanDles allows you to add Authors to the collection of handles extracted from the document. In this case, we have chosen to include 20 authors' names. Now, clicking on the Space button, we can see where the names occur on the screen in relation to the topics.

Figure 17 shows the handles map that includes author names. Note the names that appear on the screen surrounding the handle, Flight Simulators: Magee, Hamilton, Kantor, and Howard. All the authors have written about motion sickness and flight simulators, and are therefore potential collaborators. Indeed, some of them are collaborators. For example, Magee and Hamilton have two papers together on this map. Another use of the tool however, is to uncover who perhaps should collaborate. Magee and Howard are both authors on motion sickness in the context of flight simulation, but they have not published a report together. This could happen for many reasons, but the point is that the customized version of HanDles could be used to identify not only existing collaborators, but also potential collaborators during the proposal stage of a new project.

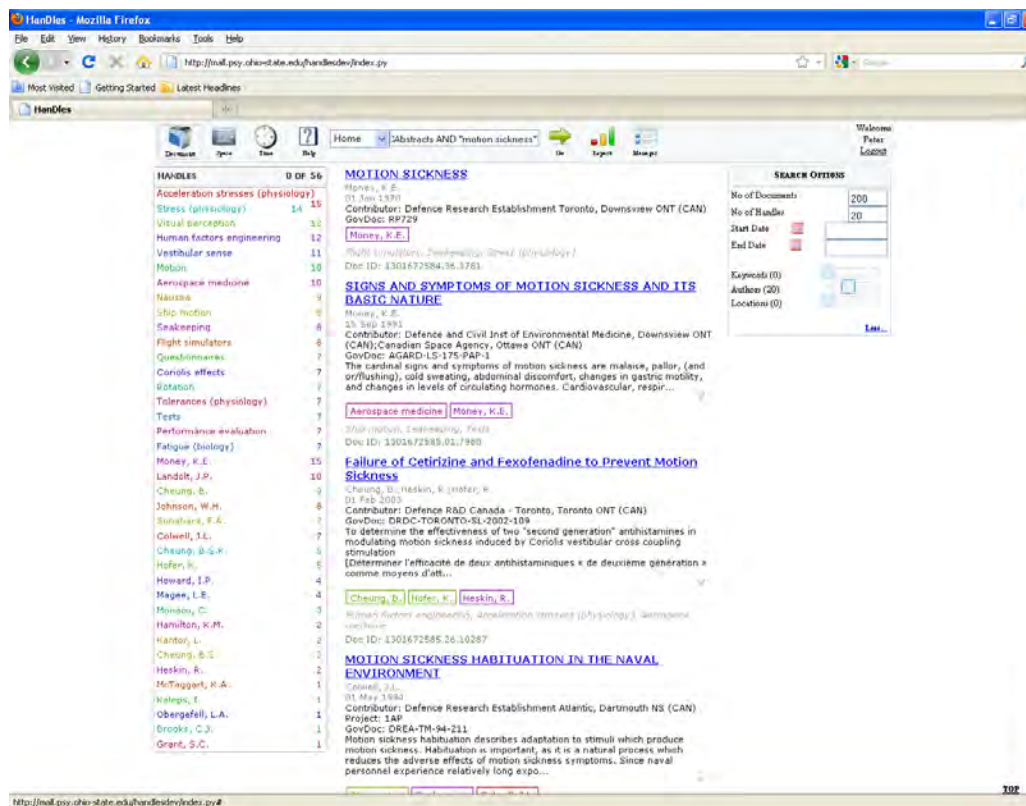


Figure 16: Adding authors to the list of handles. Note: from this screen, the user can click on a handle on the left which highlights the documents containing it on the right.

Conclusions and Recommendations

HanDles was developed with the intelligence community in mind. It seems clear, however, that it represents a capability that might be of great use to our own organization. Handles is a potential powerful tool to help DND/CF personnel find information and personnel relevant to a research topic, as well as a device to help one understand where the agency is focussing its science and technology efforts.

HanDles provides an important advantage over traditional document search tools. It is the only document visualization tool that allows a user to explore the various dimensions or topics that exist in a document. As such, it allows the user to develop a much deeper understanding of the semantic structure of a document collection than a competing tool that forces documents into a static display that forces the loss of such information.

This customized version of HanDles was developed to determine whether or not it would be potential alternative way to search for DRDC documents from the current practice. Based on the ease with which I was able to find information for each of the examples described above, I believe that this version of HanDles should form the basis of a new document search function for use by DND/CF personnel.

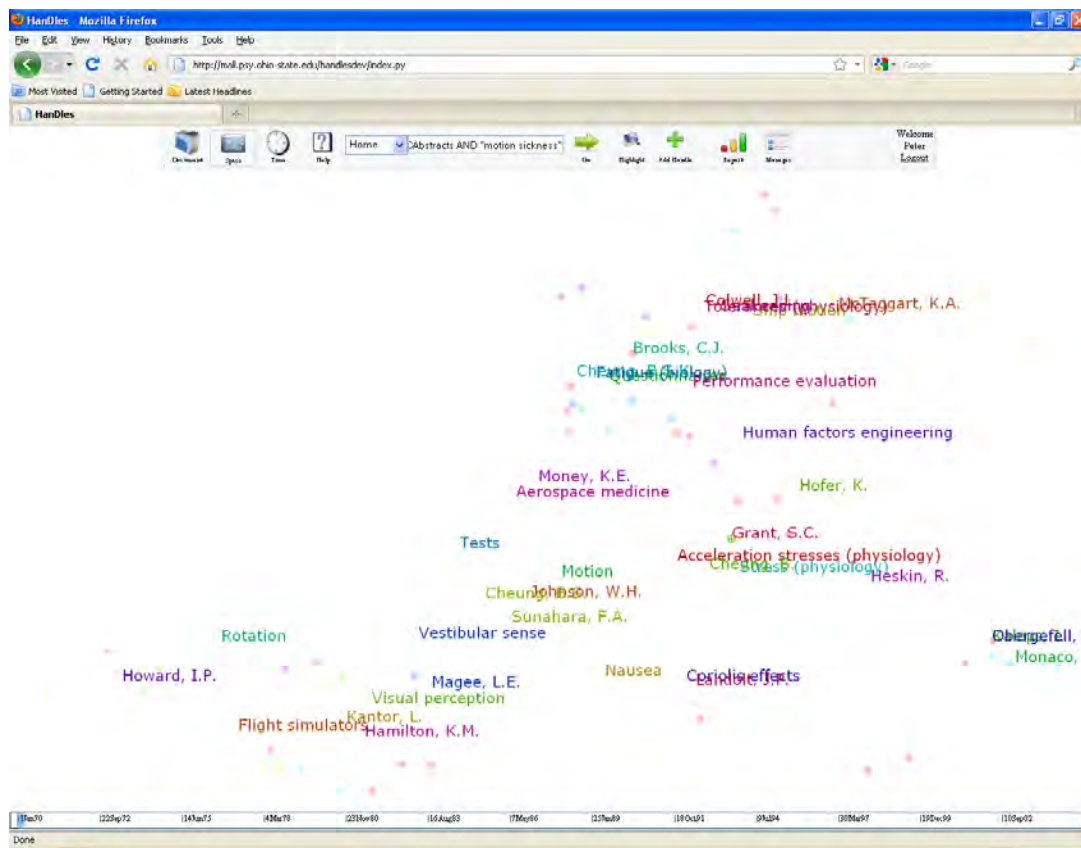


Figure 17: The HandDles map for the query, Motion Sickness with author names added.

List of symbols/abbreviations/acronyms/initialisms

CF	Canadian Forces
DND	Department of National Defence
DRDC	Defence Research & Development Canada
ARP	Applied Research Project

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1. ORIGINATOR (The name and address of the organization preparing the document, Organizations for whom the document was prepared, e.g. Centre sponsoring a contractor's document, or tasking agency, are entered in section 8.) Publishing: DRDC Toronto Performing: DRDC Toronto Monitoring: Contracting: DRDC Toronto		2. SECURITY CLASSIFICATION (Overall security classification of the document including special warning terms if applicable.) UNCLASSIFIED
3. TITLE (The complete document title as indicated on the title page. Its classification is indicated by the appropriate abbreviation (S, C, R, or U) in parenthesis at the end of the title) A Document Visualization Tool Customized to Explore DRDC Reports (U) Un outil de visualisation de document conçu précisément pour explorer les rapports de RDDC (U)		
4. AUTHORS (First name, middle initial and last name. If military, show rank, e.g. Maj. John E. Doe.) Peter J Kwantes		
5. DATE OF PUBLICATION (Month and year of publication of document.) August 2011	6a NO. OF PAGES (Total containing information, including Annexes, Appendices, etc.) 19	6b. NO. OF REFS (Total cited in document.)
7. DESCRIPTIVE NOTES (The category of the document, e.g. technical report, technical note or memorandum. If appropriate, enter the type of document, e.g. interim, progress, summary, annual or final. Give the inclusive dates when a specific reporting period is covered.) Technical Memorandum The report describes how to use a customized vesion of a document visualization tool called, Handles, to explore DRDC technical report abstracts.		
8. SPONSORING ACTIVITY (The names of the department project office or laboratory sponsoring the research and development – include address.) Sponsoring: DRDC Toronto Tasking: DRDC Toronto		
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10a. ORIGINATOR'S DOCUMENT NUMBER (The official document number by which the document is identified by the originating activity. This number must be unique to this document) DRDC Toronto TM 2011–131	10b. OTHER DOCUMENT NO(s). (Any other numbers under which may be assigned this document either by the originator or by the sponsor.)	
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(U) HanDles is a document visualization tool developed for DRDC Toronto as part of ARP 16ah. In this report, a customized version of the program is described. The new version of the HanDles tool was adjusted to process the abstracts from the agency's technical reports dating back to the 1940s. In a series of short examples, the author shows how HanDles could be used as an effective and intuitive means by which civilian and military members of the Department of National Defence can find scientific or technical information about topics or personnel with specific areas of expertise.

(U) HanDles est un outil de visualisation de document mis au point pour Recherche et développement pour la défense Canada (RDDC) – Toronto dans le cadre du PRA 15ah. Le présent rapport contient une description d'une version personnalisée du programme. La nouvelle version de l'outil HanDles a été modifiée afin de traiter les résumés des rapports techniques de l'Agence qui remontent jusqu'aux années 40. Dans une série de brefs exemples, l'auteur montre de quelle façon les civils et les militaires du ministère de la Défense nationale peuvent utiliser HanDles de manière efficace et intuitive afin de trouver des renseignements scientifiques ou techniques sur des sujets ou du personnel possédant une expertise dans certains domaines précis.

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(U) DRDC Abstracts, Handles, document visualization

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